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PRODUCTION SCIENCE

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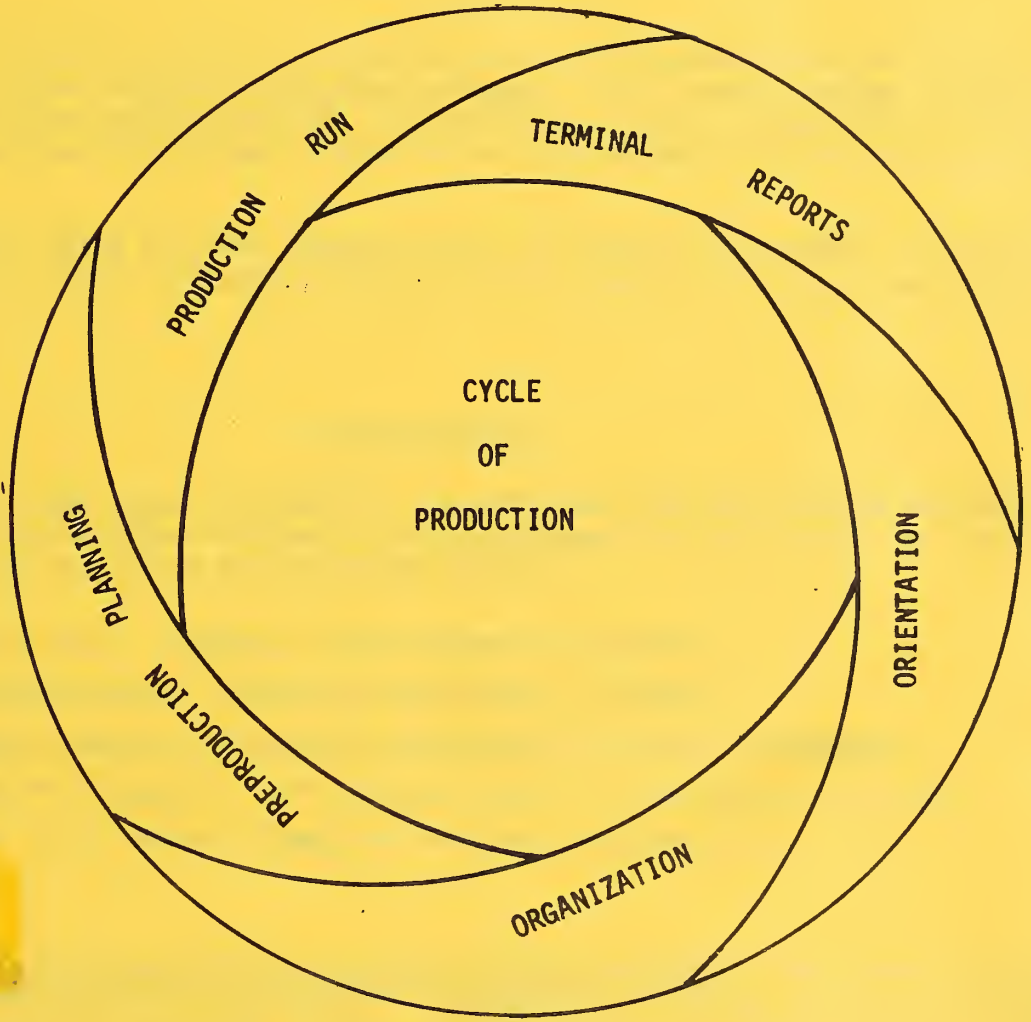

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FOREWARD

Production Science is a new course that has been developed from activities carried on in the Industrial Education program. This course, however is not dependent on the facilities usually found in Industrial Education - rather it is a method of teaching that can be utilized in other areas such as Business Education and Home Economics.

This guide provides educators with an outline for content to effectively teach the principles, concepts and processes of production of goods and services in our society.

ACKNOWLEDGEMENTS

The Department of Education acknowledges with appreciation the contribution of the many teachers who assisted in the development of the content for Production Science and in particular to the course writers:

A. A. Day, (Chairman) Department of Education

Philip Lesniak, MacDonald High School, Edmonton

Robert Mathews, Strathcona Composite High School, Edmonton

Robert Povaschuk, Harry Ainlay Composite High School, Edmonton

Dr. J. D. Harder, Associate Director of Curriculum.

NOTE: <u>This Curriculum Guide is a service publication only</u>. The Senior High School Program of Studies contains the official statement concerning courses. The information contained in the Guide is prescriptive insofar as it duplicates that contained in the Program of Studies. There are in the Guide, however, as well as content, methods of developing the concepts, suggestions for the use of teaching aids and lists of additional reference books.

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PRODUCTION SCIENCE

I. Relating Man and Technology

Interpretation and understanding of business and industry and its organization should be a major concern and objective of this course. The rationale for such a course is derived from the fact that our society is basically industrially oriented and the practical aspect of a business organization needs further emphasis in our educational system.

A worker does more than manipulate instruments, tools, and machines. He has feelings and aspirations. He is not alone in the world of work. He is constantly interacting with others, being affected by their relationships to him. The human or social aspects of industry directly affect the productivity of the worker, and for this reason must constitute an integral part of a program which prepares students for work in an industrial society.

II. Objectives

The main objective in production science is that the student understands the role that man plays in the organizational structure of industry, his influence upon production, and the various problems encountered in producing a salable product or service within a community.

It is hoped that through a production science approach the student will begin to understand:

(1) the various demands and pressures of Man on Technology and Technology on Man in order to produce a product or service;

(2) the human factors as they affect the success or failure of an organization;

(3) the interrelationship of technologies; and

(4) the mechanics of an organization.

III. Suggested Teaching Approach

It is suggested that production science simulate a typical mass production industrial activity which incorporates the basic social and human principles of an industrial organization in a laboratory environment.

The attempt to identify the basic structure of industrial sociology must not be considered as final but rather as initial and exploratory, to be modified and revised through research and experimental practice.

One approach is to design a product that will include as many technological areas as possible. Organize the laboratory to simulate an assembly line format. The students are to play roles with the opportunity to change when necessary.

Another approach is to develop an organization to provide a service.

Each class organizes its own company and has its own product. Keen competition may develop throughout the year between companies.

Monies collected from the sale of a product may cover the cost of materials and offer a small percentage return in dividends to the share holder.

NOTE: Production should be interrupted at any point for further organizational discussion or problem solving.

Emphasis should be placed on SAFETY. Some form of a safety program is the responsibility of the safety supervisor.

An attempt should be made to evaluate students by the critical incident method and the performance rating approach.

IV. Organization

A. Guide Organization

The course guides are developed on the following patterns:

1. Topic: Each course is subdivided into a number of topics.

2. Generalization: The main generalization or "big" idea that students should learn follows each topic.

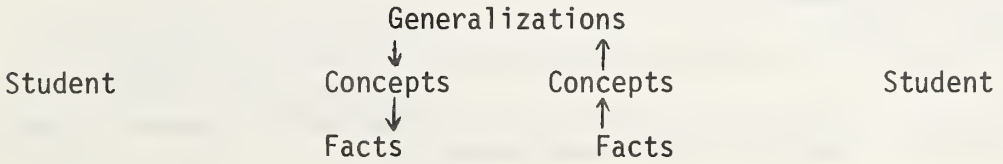
3. Concepts: The concepts divide the topic into the teaching components. They give more direction on specific areas that should be studied.

4. Behavioural Objectives: These describe specific changes in student behaviour which result from learning tasks he performs.

   The guide gives a few sample behaviour objectives. It is the responsibility of the teacher to develop as many behavioural objectives as he can teach in the time available.

Facts are taken to be items of specific information, concepts are categories of information and generalizations express the relationship between concepts.

In planning a lesson, the teacher moves down this hierarchy whereas in learning, the student begins with facts and moves upward.



5. Suggested Activities: A few suggestions are made as to the types of activities that could be used to achieve the behavioural objectives.

6. Resource Materials: This column suggests where materials may be obtained.

B. Course Organization

The course is organized as a project. The objectives of the course are achieved through the activities that the students participate in during the evolvement of the project. Teachers should be alert to capitalize on situations as they develop to help students arrive at the generalizations set out under each topic.

Careful planning is necessary for success and an important part of the course is to allow students to take an active part in the planning and the decision making.

C. Facility Organization

The organization of the physical facilities is in part determined by the original plan. There are however adjustments that can be made in the layout by the teacher to accommodate his/her style of teaching. The number of students in a class affects the way the lab is organized. The class size for such a course should be determined on the basis of the following considerations:

(1) physical size of the shop or laboratory
(2) type of student
(3) amount of equipment
(4) type of programming
(5) type of course
(6) training and experience of the teacher.

Safety of the students and their opportunity to obtain teacher contact are important considerations when class loads are determined.

V. Evaluation

Evaluation of student growth should be based on stated behavioural changes and specific criteria understood by the students. Allowance should be made for both self and teacher evaluation and in some cases peer evaluation. Evaluation should further be based on the three domains of learning as defined by an Alberta committee of Industrial Education teachers. Their categories are as follows:

a. Verbal and Written Communication
b. Personal Growth
c. Manipulative Skills

The weighting given each of the three measures will depend on the nature of the behaviour being evaluated. For a more detailed treatment of evaluation, see the Industrial Education Handbook.

VI. Production Science Content

Summary

1. An introduction to industry through production technology
   -modern civilization and industrial dependence
   -facets of industry; men, machines, materials

2. Industry and division of labor
   -job and operation breakdowns
   -flow charts
   -labor allocations

3. Personnel organization
   -industrial organization
   -formal organization
   -informal organization

4. Research and development
   -elements of a salable product
   -industrial research
   -prototype development

5. Simulated industrial production
   -industrial production
   -physical problems
   -sociological problems

6. Technological changes
   -growth of knowledge
   -technological changes and man

7. Career opportunities

REFERENCES

Books

Junior Achievement Course Materials

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Kimbrell, Grady, and Ben S. Vineyard, *Succeeding in the World of Work*. McKnight and McKnight Publishing Co. 1970

*Lindbeck, J. R. and Irvin T. Lathrop, *General Industry*. Copp Clark Publishing Co., 1969.

Lindbeck, John, *Is Package Design your Students' Bag?* Industrial Arts and Vocational Education, February, 1972. Pp. 30 - 31.

Sayles, Leonard R. and George Strauss, *Human Behaviour in Organizations*. Prentice-Hall Inc., 1966.

Toffler, Alvin, *Future Shock*. Bantam Books of Canada Ltd., 1970.

Utah State Board For Vocational Education, *Industrial Arts Production Technology*. Salt Lake City, Utah.

Whaley, Don, *Simulate Industry in A Laboratory Factory*. Industrial Arts and Vocational Education, October, 1970. Pp. 39-42.

* Most Used.

Films

Form and Formula.
16mm, sound, color, 40 minutes
The Society of the Plastics Industry of Canada, 1262 Don Mills Road, Don Mills, Ontario. Ph. 449-3444. Explains the research, development and testing of different plastic raw materials, touching on their characteristics; forms in which they are available; manufacturing processes involved; and the development and testing of finished products.

Loose Fill with Pelaspan-Pac.
16 mm, sound, color, 11 minutes.
The Dow Chemical Company, Audio-Visual Centre, Abbott Road Building, Midland, Michigan 48640.
A new product is available that takes packaging a long step forward in the search for a truly ideal loose-fill packing material. The product, trade-marked Pelaspan-Pac by Dow, consists of strands of foamed plastic. The film points out the property and cost advantages of Pelaspan-Pac over older loose fill packing materials.

Packaging With Pylite.
16 mm, sound, color, 12 minutes
Koppers Company, Plastics Division, Koppers Building, Pittsburgh, Pa. 15219.
This film illustrates the many packaging applications of Pylite foam plastic.

I am a Country.
16 mm, color, 25 minutes, 7 seconds. 106C 0167 215.
National Film Board of Canada, Centennial Building, 10031 - 103 Avenue, Edmonton.
This film provides a showcase for products manufactured in Canada, from aircraft designed for special duties to pre-cast bathrooms that can be installed in one simple operation. There is heavy duty machinery developed for the special needs of Canadian indusry. There are women's fashions of universal appeal. All bear the "Made in Canada" label and can be viewed in this film in color and at close hand.
Commissioned to Crawley Films Limited for Department of Trade and Commerce.

The Polyolefins.
16 mm, sound, color, 28 minutes.
Shell Film Library, Box 100, Calgary 2, Alberta
This film illustrates the sequential progress followed in researching and developing new materials for existing products. Three polyolefins are referred to in so doing.

Relevant Films:

a) Available from the Department of Extension, University of Alberta, Edmonton, Alberta.

	Time	Rent
All I Need is a Conference.	28 min.	$3.25
Breaking Down the Delegation Barrier.	30 min.	3.50
Critical Path.	16 min.	2.95
Discipline: Giving Orders.	15 min.	1.75
Discipline: Reprimanding.	10 min.	1.25
Emotional Styles of Human Behaviour.	24 min.	1.90
Imagination at Work.	21 min.	2.75
Improving the Job.	9 min.	1.25
Instructing the Worker on the Job.	14 min.	1.50
Introducing the New Worker to His Job.	16 min.	1.75
Maintaining Good Working Conditions.	9 min.	1.25

Generalization B. Industrial production is highly dependent on a study of the sequential operations central to a product and the associated division of specialized labour required to perform them.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Job and operation breakdowns		The student will: a. given the appropriate materials as an introduction, take a product and isolate the corresponding job and operation breakdown.	Read and discuss procedures followed in constructing job and operations breakdowns. Have students take an existing product and make a job and operations breakdown.	*Manufacturing in the School Shop* - pp. 19 - 23.
2. Flow charts and diagrams		b. given the appropriate introductory information, prepare "critical incident charts" and "plant layout diagrams" for the production scheduling of a selected product.	Read and discuss procedures followed in preparing "critical incident charts" and "plant layout diagrams". Have students take an existing product and develop related charts and diagrams.	*Manufacturing in the School Shop* - pp. 29 - 35.
3. Labour allocations		c. with an existing knowledge of job and operations breakdowns, allocate personnel to the required jobs involved in a specified product.	Following the establishment of a job and operations breakdown for a product, students can then decide on the duties required by various personnel involved in the product manufacturing and make the appropriate allocations.	*Manufacturing in the School Shop* - 38 - 40. *A Flock of Mass-Produced Ducks* - pp. 33.

Notes:

Generalization C: Industrial organizations require an interrelationship of management and labour to facilitate and coordinate the many activities central to manufacturing a product.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Industrial organization (i.) corporation (ii.) partnership		The student will: a. given the appropriate materials, isolate the various classifications of industrial organizations and discuss their advantages and disadvantages (e.g. corporation, partnership, etc.)	Following a reading assignment, a class session can be spent discussing the many classifications of industrial organization.	*Introduction to Management* - Chapter 4 and 5.
2. Formal organization (i.) management (ii.) hierarchy (iii.) communications (iv.) responsibilities (v.) unions		b. given the appropriate materials, discuss the formal organization making references to line and staff hierarchies, communication channels, responsibilities and unions.	Following a reading assignment, the aspects of formal organization can be discussed in a class by making reference to local industrial firms.	*Social Psychology of Industry.* *Human Behaviour in Organizations.*
3. Informal organization (i.) labour (ii.) interrelationships (iii.) conflicts (iv.) communications (v.) responsibilities		c. given the appropriate materials, discuss the necessity for informal organizations, the ways in which they are formed, the conflicts and pressures within them, the communication among their members and their interrelationship with the formal organization.	Following a reading assignment, the various aspects of the informal organization can be discussed in class. Reference can be made to actual student experiences.	*Social Psychology of Industry.* *Human Behaviour in Organizations.*

Notes:

Maintaining Quality Standards.	10 min.	$1.25
Manager Wanted.	28 min.	4.20
The Department Manager.	30 min.	1.75
The General Foreman.	30 min.	1.75
Man on the Assembly Line.	30 min.	1.75
The Skilled Worker.	30 min.	1.75
The Vice-President.	30 min.	1.75
The New Supervisor Takes a Look at His Job.	13 min.	1.25
Person to Person Communication	14 min.	2.25
Risk and Forecasting	10 min.	1.55
Workshop Process.	12 min.	1.35
You are at the Bargaining Table.	50 min.	4.80
Automation.	84 min.	6.25
This Automation Age.	28 min.	1.25
Men at Work.	27 min.	1.75
Dues and Unions.	17 min.	1.25
Fact Finding, not Fault Finding.	13 min.	1.75
The Grievance.	30 min.	1.80
Placing the Right Man on the Right Job.	13 min.	1.25
Shop Steward.	22 min.	1.25

b) Available from the Workers' Compensation Board, Edmonton, Alberta

Communication for Safety Series

Part #3 *Setting 'Em Straight*
Part #4 *Let's Everybody Help*

Supervising for Safety

Part #1 *Fragile - Handle Feelings with Care*
Part #2 *It's an Order*
Part #3 *Call 'Em on the Carpet.*

Multi-Media Package

1. *Planning Line Production.* Obtainable from: The American Industrial Arts Association, 1201 - 16 Street, N.W., Washington, D.C. 20036. The package includes a synchronized slide-tape set which outlines procedures which may be followed in planning line production.

Topic I: AN INTRODUCTION TO INDUSTRY THROUGH PRODUCTION TECHNOLOGY

Generalization A: Modern civilization is highly dependent upon industry. Course: Production Science 30

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Modern civilization and industrial dependence		The student will: a. given the appropriate materials, explain several ways in which modern civilization is dependent upon industry for its existence.		
2. Lab simulation of industry		b. following a presentation by the teacher, explain the significance of the course and its relationships to industry in Canada.		Film - *I am a Country.* *Introduction to Management.* Chapter 3.
3. Interrelated facets of industry (i.) Men (ii.) Machines (iii.) Materials		c. following a group discussion, explain several interrelationships among such industrial facets as men, machines and materials.		*General Industry.* Section 1.

Notes:

Generalization D: Research of salable products and the development of prototypes are essential prerequisites to any successful business venture.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Elements of a salable product (i.) markets (ii.) advertising (iii.) competition (iv.) production (v.) cost		The student will: a. given the appropriate materials, isolate elements such as markets, advertising, demand, competition, production time and costs in considering salable products and apply such considerations in suggesting a product to be produced in the lab.	Keeping the elements of salable products in mind, each student can suggest an appropriate product suitable to lab production. The resulting suggestions can then be discussed in class.	*Manufacturing in the School Shop* - pp. 14 - 18.
2. Industrial research		b. given the appropriate introductory materials, explain how research is used in industry and the methodology followed in solving problems.	View *Form and Formula* and *The Polyolefins* and discuss research on an industrial scale and its implications for the lab.	Filsm - *Form and Formula* - *The Polyolefins*
		c. given the appropriate introductory information, apply their knowledge of industrial research in developing prototypes for selected products.	Students can divide into groups and research selected products. In the process of their research the following will be considered: job and operation breakdowns, flow charts and diagrams, required men, machines, materials and money, packaging, advertising, jigs and fixtures, pricing, consumer surveys.	*Manufacturing in the School Shop* - pp. 19 - 35. *Is Package Design Your Students' Bag?* - pp. 42 49. Films - *Loose Fill with Pelaspan-Pac* - *Packaging with Pylite*

Notes:

Generalization E: Many of the physical and sociological problems encountered in industrial production can be realistically simulated and studied within the school environment.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Industrial production 2. Physical problems		The student will: a. with the knowledge gained from preceding topics, establish an organization in a lab environment and produce a selected product or service. b. given an opportunity to simulate industrial production; encounter, identify, discuss and attempt to solve physical problems such as working conditions, job responsibilities, safety, job training, quality control and advertising and relate these to realistic industrial settings.	Students can evaluate the previous research of various products and then select one or more items most suitable to lab production. A company will be established and a product or service will result. Students can offer a service or make a product and in so doing will, in all probability, encounter problems of a physical nature. Some to be aware of and discuss when the need arises: safety, working conditions, bottlenecks, job responsibilities, PERT, bookkeeping, product distribution, meeting production deadlines, wages, cost vs. profit decisions, job training, purchasing of merchandise, quality control, advertising, pros and cons of a formal organization.	

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
3. Sociological problems		c. given an opportunity to simulate industrial production; encounter, identify, discuss and attempt to solve sociological problems such as worker morale, strikes, interrelationships and communications and relate these to realistic industrial settings.	Same as above. Some sociological problems to be alert to include: groups - their function, pros and cons, communication, informal organization, work incentives, worker morale, strikes, labour and management interrelationships.	
4. Ecological Problems		a. given an opportunity to simulate industrial production; students will encounter, identify, discuss, and attempt to solve ecological problems which arise as a result of production.	Students can identify waste products, analyze the ecological effects, and suggest solutions should problems exist.	*Student Lab Manual*

Generalization F: With the exponential growth of scientific knowledge, new materials, and methods of handling them are developed. Such innovations are influential in technological change and affect the role of man in an industrial setting.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Growth of scientific knowlege		a. given the appropriate introduction, discuss several current scientific developments and their applications.		
2. Technological changes and man		b. given the appropriate materials, relate the effects that technological change has on man.	Through written activities and class discussion, many examples of technological change and the resultant effects on man's role in industry can be brought forward.	*Introduction to Management* - Chapter 1 and 2. *Future Shock.*

Notes:

TOPIC VII: CAREER OPPORTUNITIES

Generalization G: Productive society stimulates its youth in making realistic vocational choices.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Industry and the wide variety of careers which evolve.		Upon completion of the production, students will be able to identify the wide variety of interrelated job opportunities required for an industrial setting.	Students identify and present their role as part of the entire organization and follow this with a discussion, where they become cognizant of the many interrelated roles in an industrial organization.	

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